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HANDHELD ELECTRONIC DEVICE HAVING A COVER TURNABLE 360 DEGREES RELATIVE TO A BODY THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

The present invention was first described in Disclosure Document Registration 537,979 filed on Sep. 8, 2003 under 35 U.S.C. .sectn.122, 37 C.F.R. .sectn.1.14 and MPEP .sectn. 1706. This application claims the benefit of Taiwan application Serial No. 93210614, filed on Jul. 6, 2004.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a handheld electronic device. More particularly, the present invention relates to a handheld electronic device having a cover and a body; the cover can rotate 360 degrees relative to the body.

2. Description of the Related Art

Handheld electronic device is now a widely adopted term referring to those small and portable electronic devices such as mobile phones, pocket personal computers, electronic games, electronic dictionaries, personal digital assistants or portable personal computers. Because handheld electronic devices can be interconnected through wireless communication systems or the Internet, it is a versatile and efficient piece of high-tech mobile information processing equipment.

FIGS. 1A and 1B show a conventional flip-top handheld electronic device at closed and opened positions. The device has a flip cover 110 and a main body 120, which are hinged together through a hinge structure 130. The hinge structure 130 is a single pivot structure. Due to structural interference between the flip cover 110 and the main body 120, the flip cover 110 cannot be rotated 360° relative to the main body 120 to rest on a bottom surface of the main body 120, which is desirable in some applications, for example, when a user needs to use a stylus (not shown) to input information through a stress-sensitive touch screen (not shown) on the flip cover 110 of the device.

FIG. 2 is a perspective view of another conventional handheld electronic device. As shown in FIG. 2, the device has a main body 220 and a cover 210. A screen 212 is provided on the cover 210 and a keyboard 222 is provided on the body 220. The cover 210 is connected to the main body 220 through a hinge structure including a first pivot 230 and a second pivot 232. The first pivot 230 enables the cover 210 to rotate relative to the main body 220 on a vertical plane, and the second pivot 232 enables the cover 210 to rotate relative to the main body 220 on a horizontal plane, whereby the cover 210 can be moved to rest on a top surface (not labeled) of the main body 220 with the screen 212 faces upwardly. Although the hinge structure of FIG. 2 enables a user to input information to the device through use of a stylus tapping on the screen 212, this type of hinge structure enabling two-plane rotation is complicated and expensive to produce.

In U.S. Pat. No. 4,825,395, a two axis articulated hinge design for connecting the two casings of an electronic computer is disclosed. The advantage of using the two-axis articulated hinge structure is that structural interference will not occur, and one of the casings can be directly rotated to rest on the other from a top surface to a bottom surface thereof. However, one major disadvantage for this design is that there is no fixed relative position between the two

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casings except at the two end positions in which the two casings rest on each other. The hinge structure of another U.S. Pat. No. 5,898,600 also has similar problem regarding the relative positioning between the casings.

The problem of not having a fixed relative position between the two casings of a flip type handheld electronic device as in the aforementioned hinge designs can be explained with respect to FIGS. 2A through 2C. FIGS. 2A through 2C are side views of a conventional two-axis handheld electronic device. As shown in FIGS. 2A through 2C, a handheld electronic device 10 has a first casing 12, a second casing 14 and a connecting plate 16 with two edges connected to hinge axes 18, 20 of the first and the second casings 12, 14 respectively. When the second casing 14 is rotated to a vertical position relative to the first casing 12, the connecting plate 16 can be disposed in a horizontal position (shown in FIG. 2A), a slant position (shown in FIG. 2B), a vertical position (shown in FIG. 2C) or any position in-between. Since the orientation of the connecting plate 16 is quite arbitrary, the first casing 12 and the second casing 14 are not fixed relative to each other. Such an inability to fix the relative position between the two casings 12, 14 at a position between the end positions is undesirable.

SUMMARY OF THE INVENTION

Accordingly, at least one objective of the present invention is to provide a handheld electronic device having no structural interference between its cover and main body so that the cover can rotate by an angle up to 360° relative to the main body, whereby the cover can rest on either a top surface or a bottom face of the main body through a simple rotation of the cover relative to the main body.

At least a second objective of the present invention is to provide a handheld electronic device having a secure and reliable relative positioning between its cover and main body when the cover is rotated by an angle up to 360° relative to the main body.

To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the invention provides a handheld electronic device. The handheld electronic device mainly comprises a first casing, a second casing and a hinge structure. The first casing has a first pivot portion and the second casing has a second pivot portion. Each of the first and the second pivot portion has a plurality of protruding teeth. The teeth of the first pivot portion mesh with the teeth of the second pivot portion. The hinge structure has two axle rods around which the first and second pivot portions rotate, respectively. The two axle rods are securely fastened to two axle caps respectively at two opposite ends of the axle rods. Through this design, the first casing can rotate by an angle up to 360° relative to the second casing and a relative position between the two casings during the rotation can be deterministic.

The present invention also provides an alternative handheld electronic device comprising a first casing, a second casing, a hinge structure and a lever wherein the hinge structure and the lever connect the first and second casings together. The first casing can rotate relative to the second casing. The first casing and the second casing have a first pivot portion and a second pivot portion, respectively. The hinge structure has first and second pivots which are respectively connected to the first and second pivot portions of the first and second casings. The lever has a first end and a second end that are fastened to the first casing and the second casing, respectively. The first end and the second end